be used a datum reference for fixturing the diaphragm section for subsequent machining operations, including the tapering of the outer edges **116**, **118**.

In one embodiment, diaphragms **70** and **72** are mirrored images of one another resulting in the standardization of parts to further reduce costs. Diaphragms **70**, **72** are joined together by weld **84**. Weld **84** is formed by a process such as electron beam welding or similar process known to those in the art. Preferably weld **84** is made on the outside of ring **68** to improve the strength of the ring **68**.

In the embodiment illustrated, ring **68** contains a flat inner surface **120** and hyberbolic outer surface **122**. In a lubricated system, drain holes **124** are distributed around the circumference of each ring **68**. Drain holes **124** distributed around the circumference of each ring **68** allow any oil which inadvertently leaks into the interior of the undulant section **44** to escape, thus preventing the oil from accumulating therein and cause a rotary imbalance of the integral coupling **40**. A group of elbows (not illustrated) may also be associated with each undulant flexible section **44** as previously described. The elbows allow the interior of each undulant section **44** can be readily inspected with a flexible optical instrument to inspect welds or search for stress fractures or similar signs of defects.

The hyberbolic outer surface **122** contains balancing rim **126**. Balancing rim **126** is an excess of material that can be removed by a process such as machining that allows for balancing of the integral coupling system **40**. In an alternate embodiment (not illustrated), inner surface **120** also contains a hyperbolic profile or any similar shape to allow the removal of material from the inner surface for balancing the coupling system **40**.

The undulant flexible section **44** contains the following design parameter variables shown in FIG. **3**:

Ra: Diaphragm outer radius
Rb: Diaphragm inner radius
Ta: Outer radius thickness
Tb: Inner radius thickness
Ro: Outer ring radius
Ri: Inner ring radius
Rs: Shaft/diaphragm fillet radius

In one embodiment, the above variables are used to manufacture the undulant flexible section **44** with the following design parameters:

Rb/Ra<0.6
2<Tb/Ta<3.5
Ri>2*Ta
Ro>2*Ri
Rs>2*Tb

The above design parameters allow integral coupling system **40** of an epicyclic gear train the ability to accommodate the combined axial, lateral, and angular misalignments common for such systems while simultaneously allowing for the transfer of torque in the system. Integral coupling system **40**, through the non-symmetric tapered contour profile, isolates the spline system from the helical sun gear misalignment. The integral coupling system **40** primary control design parameters are the thickness and radii ratios as listed. The set of diaphragms as illustrated in FIG. **2** can be of different radial dimensions to isolate the spline system from the epicyclic gear train excursion and shaft system misalignment. Thus, the overall system is improved in reliability because the propensity for spline wear to occur is remote, and the epicyclic gearbox has the ability to operate under misalignment.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

The invention claimed is:

1. An integral sun gear and coupling assembly comprising:
a sun gear;
a spindle connected at a forward end to the sun gear, and a rearward end to a shaft of a planetary gear train, the spindle having at least one undulant flexible section for accommodating misalignment between the sun gear and the shaft, the flexible section comprising a cylindrical ring having a diameter greater than the diameter of an adjacent section of the spindle, and joined to the spindle by two longitudinally spaced apart diaphragms;
wherein the at least one undulant flexible section further comprises an outer radius Ra with a corresponding outer radius thickness Ta, an inner radius Rb with a corresponding inner radius thickness Tb, an outer ring radius Ro, an inner ring radius Ri, and a shaft fillet radius Rs, and wherein the at least one undulant flexible section has the following design criteria:
Rb/Ra<0.6
2<Tb/Ta<3.5
Ri>2*Ta
Ro>2*Ri
Rs>2*Tb.

2. The coupling system of claim **1**, wherein the sun gear is welded to the sun gear coupling to form a single structure.

3. The coupling system of claim **1** wherein the sun gear comprises a gear portion with a shaft portion extending concentrically therefrom.

4. The coupling system of claim **1** wherein the respective outer sides of the diaphragms form a hyberbolic cross-sectional profile.

5. The coupling system of claim **1** wherein each diaphragm has an outer edge member, and each outer edge member contains an interior surface that is generally parallel to the central axis of the shaft, and an exterior surface that is hyperbolic in cross-section.

6. The coupling system of claim **1** wherein each outer edge member of the undulant flexible section contains an oil drain aperture.

7. The coupling system of claim **1** wherein the undulant flexible sections comprise four uniformly sized components joined together.

8. The coupling system of claim **7** wherein the four uniformly sized components are joined by a welding process.

9. An integral sun gear and coupling assembly comprising:
a sun gear;
a spindle connected at a forward end to the sun gear, and a rearward end to a shaft of a planetary gear train, the spindle having at least one undulant flexible section for accommodating misalignment between the sun gear and the shaft, wherein the flexible sections comprising a cylindrical ring having a diameter greater than the diameter of an adjacent section of the spindle, and joined to the spindle by at least two longitudinally spaced apart diaphragms, and wherein the undulant flexible section contains two generally parallel interior walls which are generally perpendicular to a central axis of the shaft and which are joined by an outer ring member; and
wherein junctures between the diaphragms and the spindle are curved in cross section on an outer side of the diaphragms to improve flexibility and minimize stress concentrations, which result in non-symmetric contour of the diaphragm walls, and
wherein the at least one undulant flexible section further comprises an outer radius Ra with a corresponding outer radius thickness Ta, an inner radius Rb with a corresponding inner radius thickness Tb, an outer ring radius